

ISSN 1198-6727



Fisheries Centre Research Reports

2014 Volume 22 Number 3

Ecopath 30 Years
Conference Proceedings:
Extended Abstracts

Fisheries Centre, University of British Columbia, Canada

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Fisheries Centre Research Reports 22(3)
237 pages © published 2014 by
The Fisheries Centre,
University of British Columbia

2202 Main Mall
Vancouver, B.C., Canada, V6T 1Z4

ISSN 1198-6727

AN ECOSYSTEM APPROACH TO THE ROLE OF FISH FARMING IN COASTAL AREAS⁴⁷

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ABSTRACT

Coastal ecosystems put up most of the impacts from human activities in the sea. Generally, assessment based on a unispecific ecological group and/or habitat reflects only a fraction of what is happening in the ecosystem, and usually it is biased by the spatial and temporal variability at small scales. This is more evident when several human activities co-exist in the same area and interact synergically among them and with the natural structure and dynamics of the ecosystem. An ecosystemic assessment can combine several ecological groups, habitats, processes and/or activities, and offer a more holistic picture about the structure and dynamics of the considered coastal area.

Coastal intensive fish farming is wide spreading over the world, producing more than 20 million tonnes of fish per year. In the Mediterranean Sea, the number of fish farms has increased dramatically from early '80 in coastal waters (Ferlin and LaCoix, 2000), adding a new source of impacts (see Holmer et al. 2008 for a review). Fish farming release a substantial amount of nutrients (in both forms of organic matter and artificial food pellets), modifying the habitat and communities beneath cages and favouring aggregations of wild fish around the cages (Sánchez-Jerez et al. 2011). As a result, fish farming generates a large flux of organic matter, acting food pellets as a key factor fueling the ecosystem (Bayle-Sempere et al. 2013). It triggers several direct and indirect impacts in the ecosystem, which are not always evident from a single point of view.

Some ecological processes can be affected by the presence of fish farming which need a precise assessment in order to maintain the ecological status of any coastal area. Some of the potential applications and benefits of our holistic approach for a sustainable coastal management could be to:

- Estimate the carrying capacity of the system regarding the critical production suitable for a certain area. It would be one of the most important issues pointing towards the sustainable management of coastal zones.
- Estimate both the levels of escapees in the environment and the critical threshold bearable by the surrounding ecosystem in addition to estimate a level of fishing effort capable to control the incidence of escapees to affordable levels for the environment. Altogether will help to minimize

⁴⁷ Cite as: Bayle-Sempere, J.T. et al. 2014. An ecosystem approach to the role of fish farming in coastal areas, p. 104-105. *In*: Steenbeek, J., Piroddi, C., Coll, M., Heymans, J. J., Villasante, S., Christensen, V. (eds.), *Ecopath 30 Years Conference Proceedings: Extended Abstracts*, pp. 104. Fisheries Centre Research Reports 22(3). Fisheries Centre, University of British Columbia [ISSN 1198-6727]. 237 p.

the negative influence (habitat competition, genetic flow, etc...) of escapees over wild counterparts of the cultured species and/or other wild fish.

- Assess the effects of aggregated top predators on the structure and dynamics of the considered ecosystem in order to warn about undesired negative impacts on key commercial species.

EwE can be a valuable tool for understanding the effects of fish farming and predict changes on biodiversity, commercial fisheries or socio-economic activities like tourism or sport fishing. Modeled results will allow the design of reliable short-term fish farming management at the scale of the whole ecosystem considered. Combining these with the results from unispecific studies would help to enrich the simulated output by including procedures from statistical learning in order to estimate variability, standard errors and confidence intervals to the simulated data.

In our particular case, we present a first approach to assess the possible impact of fish farms on the ecosystem through changes in resilience. The hypothesis is that if resilience is affected, the level of disturbance may be estimated and thus the sustainability of the ecosystem. The findings of this experiment will be useful to formulate potential experiments and address the above questions.

ACKNOWLEDGEMENTS

This study was partially funded by Spanish Ministry of Science Grant (Project FATFISH CTM2009-14362-C02-01). JTBS thanks to Conselleria d'Educació, Generalitat Valenciana, for financing the visit to La Paz during 2012. FAS thanks support to visit the University of Alicante during 2013.

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